2006

Developing a New Program in Marine Engineering Technology

Anthony Dean
Old Dominion University, adean@odu.edu

Gary Crossman
Old Dominion University, gcrossma@odu.edu

Alok Verma
Old Dominion University, averma@odu.edu

Original Publication Citation

Dean, A., Crossman, G., & Verma, A. (2006). *Developing a new program in marine engineering technology.* Paper presented at the 2006 ASEE Annual Conference and Exposition, Conference Proceedings, Chicago, Illinois.

2006-2291: DEVELOPING A NEW PROGRAM IN MARINE ENGINEERING TECHNOLOGY

Anthony Dean, Old Dominion University

Anthony W. Dean is Assistant Professor of. He received a Ph.D. in Engineering Management and a B.S. in Engineering Technology from ODU and an MBA from the College of William and Mary. Previously, Dr. Dean was Director of Operations and Business Development for Clark-Smith Associates, P.C., and served in the U.S. Navy aboard the USS South Carolina and the USS Enterprise

Gary Crossman, Old Dominion University

Gary R. Crossman is Professor and Chair of Engineering Technology at Old Dominion University in Norfolk, Virginia. Professor Crossman received his B.S. degree from the U.S. Merchant Marine Academy in 1964 and his M.E. degree in 1970 from Old Dominion University, where he has served on the faculty for over 34 years. Professor Crossman is a Fellow of ASEE and the recipient of the James H. McGraw Award for leadership in engineering technology education. He is also a registered Professional Engineer in Virginia

Alok Verma, Old Dominion University

Dr. Alok K. Verma is Ray Ferrari Professor and, Director of the Automated Manufacturing Laboratory at Old Dominion University. He also serves as the Chief Technologist of the Lean Institute and MET Program Director at ODU. Alok received his B.S. in Aeronautical Engineering, MS in Engineering Mechanics and PhD in Mechanical Engineering. Prof. Verma is a licensed professional engineer in the state of Virginia, a certified manufacturing engineer and has certifications in Lean Manufacturing and Six Sigma. He has organized several international conferences and is currently general chair for ICAM-2006. Dr. Verma serves as the associate editors for three International Journals. Dr. Verma has developed and delivered training program in Lean Enterprise & Design for Manufacturing for Northrop Grumman Newport News, STIHL and several other companies in U.S. He has developed simulation based training programs for shipbuilding and repair industry under a grant from the National Shipbuilding Research Program (NSRP). He is well known internationally and has been invited to deliver keynote addresses at several national and international conferences on Lean/Agile manufacturing. He is active in ASME, ASEE and SME.

Developing a New Program in Marine Engineering Technology

Abstract

The Department of Engineering Technology, in the Batten College of Engineering and Technology at Old Dominion University, in conjunction with members of its advisory board and other industry representatives have begun a sustained effort to promote and develop a strong course of study in Marine Engineering Technology. Located in Norfolk, Virginia, Old Dominion University, and particularly the Department of Engineering Technology, is uniquely positioned to develop such a program. With strong ties to the world's largest Naval Base and superlative shipbuilding, maintenance and repair facilities, early qualitative research indicated high interest for development of such a program in support of one of the regions largest industries.

The Marine Engineering Technology program's goal is to provide the student with the skills necessary for success working in the commercial or naval ship design field and includes exposure to basic ship characteristics, the unique aspects of ship design, familiarization with ship construction processes and techniques, various shipboard systems, basic shipboard operations and maintenance principles and philosophies. This paper provides insight into expanding existing TAC of ABET accredited programs to meet the needs of an industry segment until the program is ready to seek independent accreditation. This paper also details the process and to-date progress of establishing this program. It also highlights the collaborative process between industry and academia in the development of new curricula to meet the needs of a particular industry segment.

Introduction

The Department of Engineering Technology in conjunction with members of its advisory board has begun a sustained effort to promote and develop a strong course of study in Marine Engineering Technology. Old Dominion University, and particularly the Department of Engineering Technology, is uniquely positioned to develop such a program. Located in Norfolk, Virginia with strong ties to the largest Naval Base in the world and superlative shipbuilding, maintenance and repair facilities (Virginia's Electronic Labor Market Access List names over 40 organizations employing individuals in Naval Architecture and Marine Engineering in Hampton Roads). This list includes Northrup Grumman Newport News, a $4 billion world-class shipbuilding enterprise, and the Norfolk Naval Shipyard and has resulted in high interest for development of such a program in support of one of the regions largest industries. A full scale program in this area will establish the Batten College of Engineering and Technology as a center of excellence in the area of Marine Engineering Technology. In taking full advantage of our proximity to some of the United States largest employers in this sector, opportunities for research funding and support are limitless.

Compatibility with Existing Programs

The Marine Engineering Technology program primary goal is to provide the student with the skills necessary for success working in the commercial or naval ship design field. Recommendations put forth by a panel composed of advisory board members of the Mechanical Engineering Technology (MET) program and local selected industry leaders in the Hampton Roads Maritime sector included: exposure to basic ship characteristics, the unique aspects of ship design, familiarization with ship construction processes and techniques, various shipboard systems, basic shipboard operations and maintenance principles and philosophies. Initial development has focused on creating an Emphasis in Marine Engineering Technology to complement the existing options (Manufacturing Systems, Mechanical System Design, and Nuclear Technology) in the TAC of ABET accredited Mechanical Engineering Technology (MET) program[5]. Within the existing MET program, students have the flexibility to choose senior electives with options in either Mechanical Systems Design or Manufacturing Systems. Some times, students choose a combination of courses from the two areas. Senior electives available to students in each of the two areas are given below in Table 1. A third option in Nuclear Technology is available to graduates of US Navy's Nuclear Power School or students who have completed a course of training for nuclear operators through an articulation agreement with Virginia Dominion Power. These students must take MET 471, Nuclear Systems I, and MET 472, Nuclear Systems II, as part of their senior electives. By adding this fourth option in Marine Engineering Technology allows students to be in an accredited program, meeting the MET program criteria, as the new option evolves. Students in the existing options and the proposed Marine Engineering Technology Option would still take common courses in areas such as computer-aided drafting, statics, strength of materials, dynamics, thermodynamics, fluid mechanics, automation and controls, and computer solid modeling. All four options then culminate in three senior technical electives and a senior project that integrates course work with a practical project assignment in the student's area of interest. Upper-division general educational requirements may be accomplished by completing a minor in Engineering Management.

Table 1 – Senior Electives within MET Curriculum

Manufacturing Systems	Mechanical Systems Design
MET 400, Computer Numerical Control in Production	MET 440, Heat Transfer
MET 410, Advanced Manufacturing Process	MET 460, Refrigeration and AC
MET 415, Introduction to Robotics	MET 450, Energy Systems
MET 430, Mechanical Subsystem Design	MET 430, Mechanical Subsystem Design
MET 445, Computer Integrated Manufacturi	EET 360, Elect. Power & Machinery
EET 360, Elect. Power & Machinery	

Table 1 – Senior Electives within MET Curriculum – Continued

Nuclear Technology
MET 440, Heat Transfer
MET 460, Refrigeration and AC
MET 450, Energy Systems
MET 471, Nuclear Systems I
MET 472, Nuclear Systems II
EET 360, Elect. Power & Machinery

Three new senior technical electives were developed, with the first being offered in Spring 2006. These electives are outlined as follows:

1. Principles of Marine Engineering I:
   This course of study includes: Fundamental Principles of Naval Architecture including nomenclature, geometry, stability, hydrostatics, structures, and motions; Ship Design Processes; and a basic introduction to Shipboard Systems such as HVAC, refrigeration, power generation, propulsion, hydraulics, electronics, cargo handling systems, seawater systems, freshwater systems, and fuel, lube and other oil systems.
2. Principles of Marine Engineering II:
   This course of study builds upon the previous course and provides a more in-depth look at shipboard systems and introduces topics such as basic shipboard operations, and ship specifications.
3. Principles of Maintenance Engineering:
   This course of study looks at maintenance systems: predictive, preventative and corrective; large scale maintenance systems, principles of reliability engineering, maritime logistics, planning for maintenance and repair, using and ordering spare parts, technical manuals, system specifications, and shipyard operations.

The development of the three additional courses, combined with existing courses at the MET senior elective level, produce the Emphasis in Marine Engineering Technology is as shown in Table 3.

Table 3 – Senior Electives within MET Curriculum
Marine Engineering Technology Emphasis

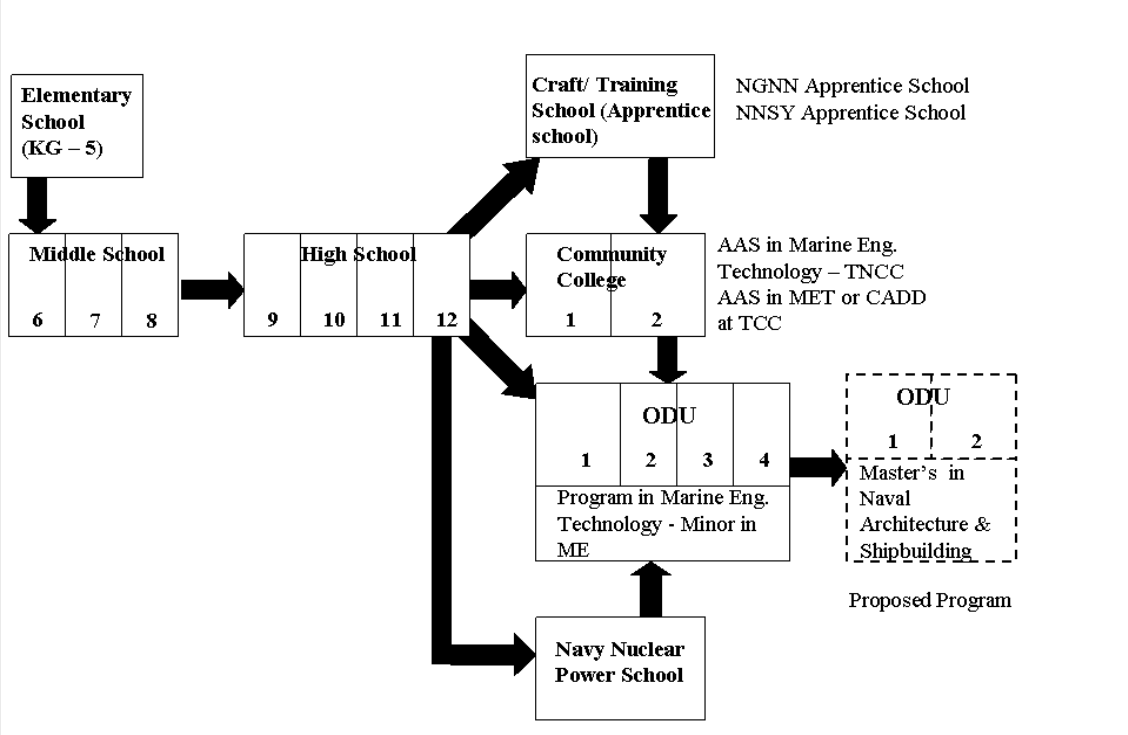
Marine Technology*
MET 440, Heat Transfer
MET 460, Refrigeration and AC
MET 450, Energy Systems
MET 475, Principles of Marine Engineering I
MET 476, Principles of Marine Engineering II
MET 485, Principles of Maintenance Engineering
EET 360, Elect. Power & Machinery

*It should be noted that additional senior elective courses are listed to accommodate those students with non-traditional degree paths with practical work experience or training in the Military and the Shipbuilding and Repair Industry. In those cases students with the assistance of the program advisor may elect to substitute a related course in lieu of MET 475, MET 476 or MET 485 based on applicable experience.

Target Student Population

Many students in the MET program enter with education and training from a wide variety of sources. Articulation agreements already exist with the Northrup-Grumman Newport News Shipbuilding Apprentice program, the Virginia Community College system, Virginia Dominion Power, and the US Navy Nuclear Power School. Many of the transferring students have some experience in the Maritime industry and are prime candidates for this program. Additionally, the Hampton Roads NROTC program (administered by Hampton University, Norfolk State University and Old Dominion University) is one of the largest NROTC units in the country. It is the belief of the MET Advisory Committee, and the special committee formed from academia, industry and the MET advisory committee, that the population exists within the region and within the existing programs to make this program is not only feasible but highly desirable to not only the student population but the employment market of this region. The initial course offering of the course Principles of Maintenance Engineering in Spring 2006 as an elective attracted over 30 students. An educational path incorporating the various routes into the program coupled with a proposed Master's level graduate program is shown in figure 1.

Figure 1 – Educational Path for Marine Engineering Technology Program



Comparison with Existing Marine Technology Programs

A search of TAC of ABET[1] accredited marine technology programs yielded two for comparison (California Maritime Academy[2] and the Maine Maritime Academy[3]). Other programs, such as the Marine Engineering Technology program at Texas A&M at Galveston[4], were not reviewed due to lack of TAC of ABET accreditation. The proposed program at Old Dominion University differs from these two existing programs in that it is not affiliated in a manner to obtain licensure as a 3rd Assistant Engineer from the US Coast Guard[2,3,4], but is focused to support the shipbuilding and repair operations of the Hampton Roads Area. The core curriculums of both accredited Marine Technology programs were very similar to the existing MET program at ODU. By adding the three electives at the senior level to create an Emphasis in Marine Engineering Technology this allows for the introduction of marine applications of theory taught in the core of the existing curriculum.

Laboratories

Current Laboratories have experimentation directly relating to the Emphasis in Marine Engineering Technology, and faculty have been requested to introduce new experiments in the existing courses to reflect the close relationship with the Hampton Roads Shipbuilding and Repair industry. In comparison to the full programs offered at the aforementioned schools, a great deal of the laboratory instruction is incurred during assignments to training on the schools training vessels and Merchant vessels. However, for students in the ODU program there is ample opportunity for Co-operative education and internships with a wide variety of Shipbuilding and maritime organizations through out the region.

Faculty Expertise

Sufficient faculty expertise and work experience currently exists within the Department of Engineering Technology for initial development and implementation of some of the electives outlined by the spring 2006 semester. Existing faculty members have strong ties to the US Navy and the Maritime industry. One served as an officer aboard submarines, another was a former enlisted nuclear operator aboard both aircraft carriers and nuclear cruisers and still another was a graduate from the US Merchant Marine Academy and spent several years as a Merchant Marine. Additionally, several faculty within the department are involved with various research projects with the US Navy, area ship repair facilities and Northrup Grumman Shipbuilding. Many of our faculty are active in the American Society of Naval Engineers.

Faculty expertise will be further strengthened by the addition two additional tenure-track faculty in the area of Marine Engineering Technology. One position will be housed within the MET program. Minimum qualifications this individual, as determined by the advisory board, would be a Master's degree in Marine or Mechanical Engineering, Technology or a related field. Registration as a professional engineer is preferred. Several years experience in the marine industry, with expertise in at least one of the following areas: naval architecture, ship operations, ship maintenance and shipbuilding is required. Candidates should have a demonstrable teaching proficiency. The other position will be housed in the Electrical Engineering Technology program

and will require prior industrial experience and successful teaching experience in the areas of basic circuit analysis, electronics, and fundamental digital circuits. Additional expertise related to technology, communications, electromagnetics, and control systems as related to marine shipboard electrical technologies and the general maritime industry. Minimum educational background is a master's degree in electrical engineering or engineering technology or closely related area. A Ph.D. and/or professional registration are preferred

In addition to course offerings with in the MET program, Old Dominion University's School of Business and Public Administration also houses the ODU Maritime Institute which offers courses in areas related to port operations, maritime transport, international supply chain management and logistics. Beginning in the Fall of 2006 the School of Business and Public Administration will begin offering a Bachelor in Science in Maritime Logistics. Within the College of Engineering and Technology, there is a proposal requesting a Master's in Naval Architecture and Ship Building. Students interested in additional course work may continue their education in those operations related to the maritime industry, with the possible attainment of a graduate degree in either Engineering or Business.

Future Program Goals

As the program progresses and feedback is received from the employers of the graduates under this option, the MET advisory board, and other stakeholders in the program, additional electives and or modifications to the above electives will become necessary. As enrollments increase, the options will evolve into a separate accreditable B.S. program in Marine Engineering Technology, of which there are only two in the country and both of these are at state maritime academies. Feedback from the advisory committee and industry representatives has been strong for building a separate degree program. It is anticipated that this program would be presented to TAC of ABET for accreditation during the next cycle which is 2011. With appropriate faculty in place, future plans include the development of a graduate program in Marine Engineering, as well as certificate programs.

Bibliography

1. Accreditation Board for Engineering and Technology, http://www.abet.org, February, 2006
2. Cal Maritime, http://www.csum.edu/academics/Majors/MET/ , February 2006
3. Maine Maritime Academy, http://www.mainemaritime.edu/academics/index.php?c1=Academics&c2=MET , February 2006
4. Texas A&M University at Galveston, www.tamug.edu/Academics/programOverview.htm, February 2006
5. Old Dominion University, http://www.eng.odu.edu/et/academics/met/met.shtml, February 2006